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ABSTRACT

Presented is a report that includes condensations of papers presented on interdisciplinary curricula, evaluation and dissemination and of the reactions to these papers. The full papers and reactions are in the appendix. The report also includes the highlights of discussion sessions at which small groups reported. The final section summarizes the recommendations on future directions for pre-college science education that were made by small discussion groups and presented by a panel in the final session of a meeting of curriculum developers. The meeting was arranged by the staff of the Materials and Instruction Development Section of the Division of Pre-College Education in Science of the National Science Foundation. Papers presented related to such topics as: (1) Science, Schooling and Society: The Search for an Integrated Curriculum; (2) Pragmatism--The Key to Changing Schools in the Seventies; and (3) Value Systems, Approaches, and Accountability (a reaction to another author's paper on evaluation and curriculum development). (Author/EB)

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CURRENT ACTIVITIES AND THE TASK AHEAD

SE 019 703

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Report of the

NATIONAL SCIENCE FOUNDATION

PES/MIDS Project Directors Meeting

13-15 September 1974

Airlie House
Warrenton, Virginia

. . . we need to understand science
and technology that is relevant
to the human condition.

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INTRODUCTION

The value of exchanging information and ideas among science curriculum development projects has long been recognized by curriculum developers. In previous meetings of developers of science curricula supported by grants from the National Science Foundation, the main concern has been the progress of each project, and how each project achieved successes and solved difficulties.

The unique feature of the meeting of curriculum developers in September 1974—the subject of this report—was the concern for the broad picture of pre-college science education, rather than with the details of individual projects. Discussions at the meeting, which was held at Airlie House, Warrenton, Virginia on 13-15 September 1974, focused on three areas: developing interdisciplinary science curricula; formative and summative evaluation; and dissemination and implementation.

Consideration of each of these areas was begun with a formal paper presented by a curriculum developer. Each paper was followed by a critical reaction by another participant, and this in turn was followed by an hour of discussion by the participants meeting in six small groups. A summary of the discussions was presented in a following plenary session.

During the last afternoon of the meeting, the project directors assembled again in small groups to exchange ideas and to make recommendations on future directions for pre-college science education. Summaries of the deliberations of the groups were

presented in a final plenary session by a panel consisting of a representative from each group.

This report includes condensations of the papers on interdisciplinary curricula, evaluation and dissemination, and of the reactions to the papers. The full papers and the reactions are in the Appendix. The report also includes the highlights of the discussion sessions at which the small groups reported. The final section of the report summarizes the recommendations on future directions for pre-college science education that were made by the small discussion groups and presented by the panel in the final session of the meeting.

The meeting was arranged by the staff of the Materials and Instruction Development Section of the Division of Pre-College Education in Science of the National Science Foundation under the direction of Dr. Laurence O. Binder. Dr. Jean B. Intermaggio, Program Manager of MIDS/PEDS, assumed major responsibility for organizing the meeting. The Office of Science Education of the American Association for the Advancement of Science assisted with the arrangements for the meeting and prepared this report.

Arthur H. Livermore
Office of Science Education
AAAS

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INTEGRATED CURRICULA

Condensation of **Science, Schooling and Society: The Search for an Integrated Curriculum.** Peter B. Dow.*

The fragmentation of knowledge, "the fatal disconnection which kills the vitality of modern curriculum" (Whitehead, 1912), continues today. We are adding endlessly to the list of available subjects while neglecting to ask what organizing ideas and principles give meaning to the academic quest.

From the beginning, Americans have equated education with the preservation and improvement of society. Through cultivation of intellect, virtue, and a love of liberty, citizens will perpetuate the free society. (Thomas Jefferson.) Academic achievement should be subordinated to the promotion of human values. (Horace Mann.)

Who speaks for the aims of education today? Our voices are easily drowned out by the demand for accountability and efficiency, the quantitative values of a technological age. John Dewey in his Pedagogic Creed (1897) reiterated his underlying assumption of American education: the training of the mind and the shaping of character cannot be divorced from a consideration of the values of the society of which the educational system is a fundamental part.

*Full paper — page 31.

In the years following Sputnik, science-based curriculum developers paid little heed to the social purposes of instruction. Piaget and Bruner stressed child development and cognitive growth. No one talked much about the child as a social creature. Curriculum developments contributed to curriculum fragmentation.

Now we are in the midst of a second wave of curriculum reform that is attempting to close the gap between curriculum development and social need through an approach to curriculum making that relates the teaching of "disciplines" to the needs of society.

An example of the new approach is the high school course **Exploring Human Nature.** The course draws on biology, anthropology, psychology, and sociology to help students understand what it means to be a human being in a society that has distinctive norms and values, and as a member of a species having some generalizable traits that are a product of a long evolutionary history.

The most interesting issues in the study of human behavior fall *between* the disciplines. For example, to begin to understand a simple behavior such as a two-year-old speaking requires input from the fields of physiology, biology, child-development, social psychology, anthropology and linguistics.

In **Exploring Human Nature** the materials are organized around issues falling between disciplines and that appear to be interesting to students—child-rearing practices, male-female differences, love and affection, expressions of fear and anger, parent-offspring conflict, and so on.

Among the problems encountered by the scholars, teachers and curriculum writers as they developed **Exploring Human Nature** were:

1) Differences in the terms used in different disciplines to name the same phenomenon—for example "bonding" (biology) and "love" or "attachment" (psychology) to describe relationships between male and female or parent and offspring.

2) Disciplines draw on bodies of data that do not overlap; for example, anthropologists are safe while they examine preliterate cultures, but are suspect when they work on recorded history, and psychologists may examine interpersonal behavior but do not extrapolate their findings to a theory of society.

3) The cleavages between the natural and social sciences constitute, in extreme cases, fundamentally different points of view regarding the nature of man. Some social scientists go so far as to

assert that cultural evolution proceeds quite independent of biological factors (White), while some biologists proclaim the primacy of biological forces in understanding human behavior (Ardrey).

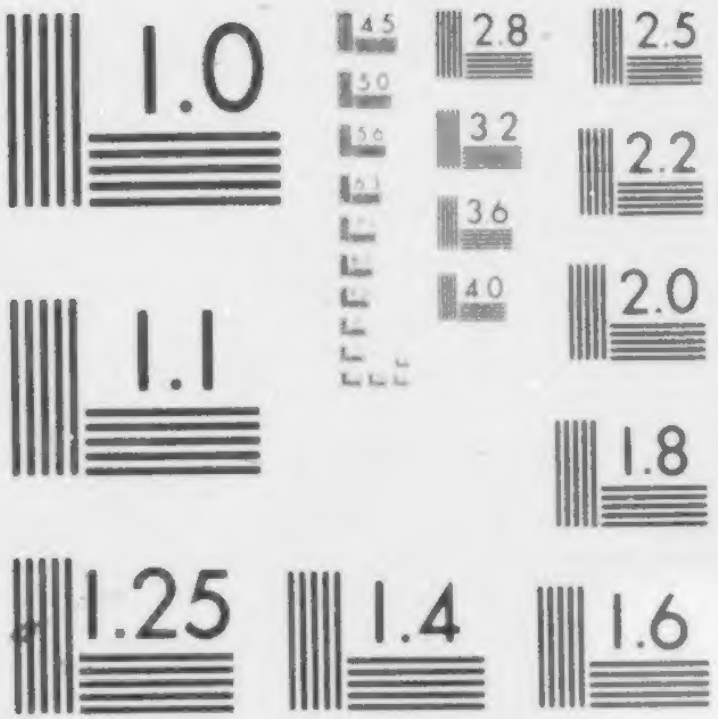
Neither extreme view is satisfactory, for it is in the interaction of biology and culture that some of the most interesting insights into human behavior emerge. Extrapolating from experiments with rats, it is reasonable to postulate that human beings are predisposed by the evolutionary past to respond differently to environmental forces.

Another example of the power of combining insights from biology and social science is in the study of pair bonding and the evolution of the human family. Social science alone cannot explain the persistence of the family as a fundamental unit of society. Biology asks, "Why should natural selection favor pair bonding between human males and females?" In this way biology informs the social sciences. By combining the insights of biology with those of anthropology we are able to provide students with a more comprehensive way of thinking about human nature than any single discipline allows us.

One of the most fruitful fields for interdisciplinary curriculum work is in environmental studies. Here the natural and social sciences can interact to explain the workings of the ecosphere and to frame the crucial issues of our relationship to the environment.

It will take courage and energy to bring about reforms in education. Scholars and teachers alike are trapped in a conventional pattern of curriculum organization. The gatekeepers at the schools are skeptical that they cannot identify what disciplines children are studying when they are following an interdisciplinary approach to real world problems.

But we must take heart and remember that it is our own humanity and that of our students that we seek to rescue from those who would wrest it from us. "The frustration . . . in which we are mired today will not leave us until we believe in ourselves again, assume again the mastery of our lives, the management of our means." (MacLeish.)



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

REACTION

Condensation of **Integrative Curricula**—a response to Peter Dow's paper. James T. Robinson.*

Besides the questions and issues discussed in Peter Dow's paper, there are additional problems that need to be considered.

Student disaffection is an issue that needs more elaboration. What students, at what age levels are disaffected by what curricula, under what conditions, and for what reasons? We need much more precise information on this problem to help determine curriculum policy. We also need to decide if we care about students' reaction to curricula. The ideologies of curriculum developers usually have more to do with proposals for solving the problem than does information about the problem. I would urge that any single solution, including integrated curricula, be reviewed very carefully before it is applied to all curricula, for all students, at all levels—kindergarten through graduate school.

I would like to reformulate the student disaffection question to ask, "How does one design a curriculum so it will have personal meaning for each student?" This question may need to be answered in different ways for different students in different curriculum areas. Dow suggests that integrated curricula can contribute to solving this problem.

The issue I am raising is that I think interdisciplinary structures are necessary, but are not in themselves sufficient elements to contribute to the resolution of the problems Dow raised. We also need to give serious consideration to how the curriculum should be organized, what are to be its essential means, and what are its desired ends. And, I believe that the question may require different answers for students at different levels within the educational system.

I suggest that we not consider our job done with the invention of new integrative concepts. We need to invent alternatives to an academic organization for integrative curricula, alternatives that may vary considerably from kindergarten to graduate school.

Redefining the broad areas of knowledge and transmitting them to students is implicit in Dow's presentation. Kohlberg and Mayer (1972) have recently argued that human development, as distinct

*Full paper — page 43.

from cultural transmission, should be the proper aim of education. Piaget's (1973) position is that logical thinking is created through organism-environment interaction, a process that seems to me to be quite different from a student appropriating someone else's explanations. To me, this suggests that the importance of the child's constructing his own explanations of objects and events is an important curricular means. The ends, for some period of time, would be explanations that would be divergent from the best simplified scientific explanations.

Interdisciplinary curricula that use presentation of the formalisms as a means may not resolve the problem of personal meaning and student disaffection. Interdisciplinary curricula that are organized in ways not meaningful to students may not resolve these problems.

A final question I would raise relates to how we attack the problem of fragmentation. Most efforts that I am aware of, have attacked the problem by developing curricula for a single subject for one or several years of a student's experience. Would it not be opportune to attack the problem by developing a full program, say for fifth graders or for eighth graders?

DISCUSSION

Highlights of the Reports of the Discussion Groups

- The mission of education includes both general concerns with life and special concerns with discipline and professions.
- Excitement in learning often stems from the *differences* between and among the various disciplines.
- Problem-focused curricula can be used to clarify a discipline.
- The educational process should emphasize invention—not merely affirmation.
- We seek continued inventiveness and development as classroom activities with teacher and students *both* active participants.
- During the '60s the emphasis in curriculum development was on scholars and educators—on structure content and structure process. The new emphasis should be on students—on structure access.
- Dealing with problem-solving is a discipline in itself.

- The child should have problems relevant to him at his age.
- Teach children how to deal with problems rather than teaching the problems of society.
- In the university so much time is spent learning the disciplines that the student comes out in the world without being able to integrate.
- Interdisciplinary programs must have local components since 'social utility' and 'personal meaning' change rapidly in time and from place to place.
- Expect and be willing to make trade-offs. Interdisciplinary programs cannot maintain all that is contained in previous programs.
- Meet the challenge of established 'gatekeepers'—the 'givers' to teachers and to students, the 'givers' of funds, the 'givers' of printed space and the 'givers' of ideas.
- Rethinking and restructuring classroom management systems must accompany innovative programs.
- Is there a danger that interdisciplinary programs will extinguish the disciplines?
- Ask for competence—not courses.
- Do not prescribe the same curriculum for all students at all grade levels—provide alternative pathways.
- Don't prepare curriculum—prepare instructional units.
- Do problem-solving skills constitute what we mean by interdisciplinary?
- Is the drive for interdisciplinary curriculum one that comes from the needs of the child? Or is it the result of educators reacting to the standard curriculum? Is child development theory accounted for in such a curriculum? Is curriculum reform a series of pendular motions ranging from narrow focus on a discipline to a broader interdisciplinary approach?
- Skills themselves might be better learned in a problem-solving context.
- "I know I will learn to add when I need to add, but how will I know when I need to add?" (child to teacher).
- Question: Has there ever been an effort to start at kindergarten and write the whole package?
  Answer: A group at the University of Rome is working on a totally integrated inquiry-oriented program. (See SCIS newsletter, Fall 1974.)
- The first step is to find out *how children learn.*

EVALUATION AND CURRICULUM DEVELOPMENT

Condensation of **Some Thoughts Concerning Evaluation and Curriculum Development.** Robert Karplus*

The basic ingredients of evaluation are an observation and a judgment. All decision-making involves evaluation in some way. Evaluation is a part of everyone's daily life.

Evaluation of individual students is a concern of the classroom teacher. Evaluation of groups of students, with data treated statistically, is the concern of curriculum specialists. Standardized tests, which are the concern of school administrators and the general public, are of no value, or possibly of negative value, to curriculum specialists because standardized tests are rarely related to relevant curricular content, require a great deal of reading by the test-taker, and discourage thoughtfulness.

The most controversial aspect of education is the value system within which the judgment is made. One approach is to identify educational objectives, perhaps in behavioral terms, and to use students' average progress as a yardstick for making judgments. This procedure is limited because objectives for many cognitive and affective aspects of a teaching program can never be constructed.

*Full paper — page 47.

A second approach to defining the value system is through implicit agreement among members of the development team. The instinctively shared values, a 'platform' (Walker), can encompass many more aspects of a teaching program than can a list of objectives. A platform complements the objectives approach. My personal preference is to minimize common basic outcomes (objectives) and maximize the freedom for individuals to develop and pursue their own objectives.

'Formative evaluation' (Scriven) based on the value system determined explicitly, implicitly, or in combination, is useful in improving the course while it is under construction. In formative evaluation, interviews, conversations and classroom observations are likely to be more informative than the usual testing approach. All members of the development team should participate in formative evaluation.

'Summative evaluation' assesses the overall value of a new course after it has been completed. This is an ambitious task which calls for defining values outside those selected by the developers. It has been suggested that summative evaluation be merely a fact-finding activity (thus avoiding value definition), or that it be 'goal free' (Scriven) with the evaluator applying his own value system.

The usual experimental design with experimental and control groups, and pre- and post-tests—called the 'agricultural paradigm' (Parlett) has limited value compared to 'illuminative evaluation,' a more clinical procedure in which observations and interviews are used, as well as tests, to probe the many aspects of a program.

Illuminative evaluation is geared to identify both short-term outcomes and potential long-term influences, though the lack of educational theory makes it impossible to extrapolate reliably into the future.

Another dichotomy is 'public' and 'private' evaluation. Public evaluation is an activity whose results are used by a professional group and which must be communicated, usually through journal publication. Private evaluation is intended for the use of the evaluator and his close associates. It is the vital component of successful curriculum development.

Public evaluation in curriculum development is likely to be counter productive. All real decisions are based on private evaluation. Public evaluation is an after-the-fact rationalization.

REACTION

Condensation of **Value Systems, Approaches, and Accountability**—a response to Robert Karplus's paper.

H. Russell Cort, Jr.*

As a researcher and evaluator, I find myself in essential agreement with some points made by Karplus, confused about the purpose of some, and disturbed about the straw-man quality of others.

The issue of evaluation is not whether it is done or not, but how, by what rules of evidence, and according to whose criteria. Values are always present and affect what one observes, interprets, and decides. For this reason it is appropriate to have an outside person involved in formative evaluation.

The basic problem of evaluation is to determine how you know whether something is or is not—how much or what kind of evidence do you require to decide that a student has mastered something.

The foremost problem is deciding what questions are important to answer within the limits of time and resources. The value problem becomes more evident as you get down to considering what is worth evaluating and how much it is worth. The teacher, for example, must trade-off amount of mastery desired against interest or motivation, since one level of mastery may enhance retention but a slightly reduced level may enhance continuing interest in the subject.

The most important practical problem is not behavioral objectives versus a meta-language among the development team, but determining users' needs. An evaluator wants to know what are the users priorities with respect to questions and information, and what are their criteria of success and effectiveness.

I think the public/private dichotomy is somewhat a straw man. Public evaluation need not be counterproductive; private evaluation could be misleading and negative in its consequences.

The developer of a curriculum may have a set of shared values about the materials developed. However, once in public use, the curriculum becomes subject to use and judgment according to value systems beyond the developers control. Perhaps a useful function of formative evaluation is to bring a wide range of values

*Full paper — page 52.

to bear so the designers can decide what they want to do about anticipated reactions.

The field of evaluation seems to suffer from a dearth of good examples and from a plethora of models. It sounds as though I am suggesting that evaluation, as an operation and a process, now has sufficient constructs, models and methods to proceed in straightforward, effortless, or automatic fashion to support curriculum development and implementation effectively at any stage and at no great cost.

Not necessarily so. Evaluation still has basic design problems to confront analogous to those of curriculum design. It seems that curriculum design wrestles with the perennial questions of:

What to teach?
When to teach?
How to teach?

Similarly, evaluation perforce addresses the question of:

What to observe or measure?
When to observe?
How to observe?

I have found myself pondering the question of accountability in curriculum development. To whom is the curriculum developer accountable, and for what?

Part of the problem here comes about from the concept of accountability. A perusal of the literature does not induce confidence that there is a universal, mutually shared platform here.

In any case, I suggest that one form of accountability in curriculum development consists of obtaining and using information about students needs and abilities for different age levels and backgrounds. Determining teachers' needs and abilities is another. Further explication of the performance characteristics of materials is a third.

DISCUSSION

Highlights of the Reports of the Discussion Groups

- There is need for good hard evidence that the curriculum you are concerned with is paying off.

- The greatest threat to curriculum development is the lack of good evaluative data.
- Developers' evaluation may be different from that of the user.
- What kind of evidence is likely to be convincing to users? Some suggestions:
  - Cost
  - Attractiveness
  - Treatment of controversial issues
  - Minority writers in the project
  - In what sorts of schools trials were made
  - Evaluation data. External judges may be more important
  - Comparison with local, state, or national objectives
- Good summative evaluation of a new curriculum is very expensive—perhaps $500,000. Is it NSF's responsibility, or the developer's, or some outside agency's?
- Does national evaluation meet the needs of local schools?
- Well designed evaluation study does not represent the dichotomies identified by Karplus.
- Educational innovation is a continuously dynamic process—evaluation also must be continuous.
- Development and evaluation are separate functions, but evaluators and developers must interact.
- Students tend to give you the answers you want.
- To insure teacher cooperation, involve them early in the evaluation process.
- Summative evaluation is not necessarily useful, because education is continuously changing.
- Formal pencil and paper 'public' examinations are a weak measure of a complex set of interactions.
- Overemphasis on evaluation may result in people fearing to do things in education that can't yet be evaluated.
- How are we going to find some instrument or means to convey to the public information as to the real impact a project is making?
- Objective standardized tests are based on a very primitive theory of knowledge.
- Caution: intuition has a way of feeding on itself, so there is a need to reconcile subjective evaluations with objective data.
- There is political pressure to show impact in numbers. 'Rate of adoption' is less important than effects on students.
- We need to evaluate the cost effectiveness of evaluation. Is it really worth it?

- What is more important—measurement of achievement of basic skills or assessment of student interest and satisfaction?
- Evaluation results may be used to convince the public your product is good.
- NSF might put more formative evaluation money into high-risk projects.
- Formative evaluation is relative to the population tested. The final curriculum product may be O.K. for the population tested but not for other populations.
- Standardized tests and external exams hinder the implementation of a lot of our products.
- Evaluation is tougher than development.

DISSEMINATION

Condensation of **Pragmatism—The Key to Changing Schools in the Seventies.** Ernest Burkman*

In the early sixties when science could do no wrong, the curriculum developer who could build a better mousetrap could expect the world to beat a path to his door.

But today many future-shocked Americans want to slacken the pace of change, and most have become economic conservatives. Science now ranks far behind the three R's on most lists of educational priorities. To be a successful change agent one must beat a path to the world's door.

I have organized my remarks into seven propositions, each accompanied by a rationale and some implications for curriculum developers.

PROPOSITION 1—Those likely to be affected by a curriculum development effort must participate in its planning and execution.

Rationale—Involving many people of many types not only insures a curriculum project of important input, but is also the surest way to convert doubters into supporters.

Implication—Development teams should be large and have diverse representation.

*Full paper — page 59.

PROPOSITION 2—Field testing is an act of dissemination as well as a way to collect feedback.

Rationale—Most teachers and school districts assume that their problems are totally unique. Seeing curriculum materials being successfully used in local or nearby classrooms is the strongest motivation for adoption.

Implication—Field testing should involve large numbers of students distributed nationally according to population density.

PROPOSITION 3—The final curriculum product will be sold at a profit in a highly competitive market.

Rationale—To attract and maintain the cooperation of a first-line publisher projects must insure during *development* that the final package makes sense commercially as well as pedagogically.

Implication—During development, projects must insure that: (1) the price of the final package will be competitive, (2) the publisher will have the rights to enough material with sales potential to generate a profit, (3) the product will appeal to large numbers of prospective users.

PROPOSITION 4—Implementation must not depend upon extensive modification of school facilities or large expenditures for equipment.

Rationale—Future science instruction will be done almost entirely in existing buildings and classrooms. School science budgets are declining so schools will reject any program that calls for large investments in plant or equipment.

Implication—Projects should exclude learning activities which require large expenditures for implementation regardless of their pedagogical advantages.

PROPOSITION 5—The content of new curriculum materials must be consistent with existing course patterns.

Rationale—Teacher training and certification, classroom design and equipment, graduation requirements, and other vital matters serve as powerful deterrents to change, so adoption of totally new content thrusts is difficult and unlikely.

Implication—Projects seeking to infuse new content into the curriculum should add new parts to old courses rather than demand or assume course deletions and additions.

PROPOSITION 6—New curriculum materials and approaches must be useable by present teachers.

Rationale—Over the next several years, relatively few new teachers will enter the profession, so developers must count on people already in the classroom to implement their products.

Implication—Projects must temper their zeal to introduce new content and instructional procedures to match what can realistically be expected of teachers now in the school.

PROPOSITION 7—Curriculum projects must release their products at a time of high interest in the type of innovation being promoted.

Rationale—Social conditions, more than any other factor, determine school curriculum practices. Good materials can stimulate or institutionalize directions that are already underway, but rarely do they initiate new movements.

Implication—Projects that are out of tune with social conditions should not be started, and those that are in tune should be completed with dispatch to avoid losing the 'teachable moment.'

REACTION

Condensation of **Pragmatism—The Key to Changing Schools in the Seventies.** A Response to Ernest Burkman's Paper. E. J. Piel*

While I agree with the essentials of Dr. Burkman's statement of the *problems*, I am in strong disagreement with many of the *propositions* and implications.

There is no question that educational institutions are resistant to change. The question is whether we should accept this resistance as insurmountable and concentrate on short term success.

If Proposition 1 is valid—that those likely to be affected by a curriculum development *must* participate in its planning and execution—the sixty million or so students in schools must participate in the planning and execution of national curricula. It is the students who *should* be the ones most likely to be affected. In actual practice however, it is often the scientists, science teachers, and administrators who are affected and the final effect never gets to the students.

Another question arises on widespread inclusion of teachers, administrators, etc., and that is the question of timing. With the present economic situation, it is not feasible to include large num-

*Full paper — page 62.

bers of these people in curriculum development at planning phase when the philosophy, objectives, and approach are usually set.

And so while I agree with the proposition, if it includes students and eliminates the word *must*, I have strong reservations as to the rationale and implications and the economic feasibility if carried to any reasonable conclusion.

Proposition 2 is straightforward and logical. Field testing is indeed an act of dissemination as well as a way to collect feedback. My only concern here is the realism of field testing with large numbers of students. The larger the number of students involved, the greater the variety of observers (or filters) through which the feedback must be returned and the less valid such feedback becomes. It would seem that a small number of feedback centers, chosen for their resistance to the Hawthorne Effect, might be a more feasible way to obtain valid feedback while including large numbers in a second phase to develop a firm dissemination base.

Proposition 3—Curriculum projects must specifically design their final product to be sold at a profit in a highly competitive market is a proposition up with which I will not put. I still believe that curriculum projects must specifically design their final products to meet the educational needs of the community for which they are being designed. This is the major *criterion*. One of the *constraints* is that it must be sold at a profit in a highly competitive market.

While I object to the proposition, I can agree with the implication statements with reservations. They are that projects must accept *some* but not *whatever* constraints to insure that the commercial selling price will be competitive, publisher will have exclusive sales rights, and that the final package will have reasonable numbers of sales.

While I agree in principle with Proposition 4—most projects should refrain from developing curricula which require large expenditures for new equipment—there would be little progress in the entire area of computers in the curriculum if this had been followed by all curriculum projects in the past.

Curriculum projects involving computers would not be as far along as they are if it were not for USOE and NSF support of projects which *did* require large expenditures for new equipment.

It is true that the computer manufacturing companies have also pushed for this acceptance. It is also true that the chaotic situation regarding educational computing facilities on college campuses is due to the fact that the introduction of computers to

colleges was through the manufacturers rather than through curriculum reform.

To exclude learning activities that have pedagogical advantages is to develop nothing new if it costs money. When a school administrator says "I like your program but it costs too much" what he really means is "I don't like your program enough to spend the money on it."

Proposition 5—The content of new curriculum materials must be consistent with existing course patterns.—like many of the preceding ones accepts the status quo as correct and irrefutable. If we really believed that, none of us would be here today. I would prefer to see the federal government supporting a number of new thrusts at changing existing course patterns (just to see what happens) than to support only programs which result in little more than a text revision.

A survey of two schools in the immediate vicinity of my office indicates the addition of over thirty courses to the curriculum since 1970.

While many of these courses might be considered as 'mickey mouse' courses, the point is that schools are willing to put in new courses. Interestingly, these are schools which have consistently faced the problem of voters turning down budgets during these same five years, as well as in previous years.

While I agree with the rationale of Proposition 6—New curriculum materials and approaches must be useable by present teachers—that relatively few teachers will enter the profession, I cannot accept the concept that projects must match what can realistically be expected of teachers whose training and experience ended in 1970. Curriculum change should be the impetus behind the re-education of these teachers. The implication here should really be that more money must be spent in teacher education for the purpose of implementing new curricula.

It is good to hear in Proposition 7—Curriculum projects must release their final products at a time of high interest in the type of innovation being promoted—that we are still interested in promoting innovation. However, to say that we will time the release of final products at a time of high interest is again to assume that our final products will not be leading the changes in schools but following them.

If education in 1980 is totally out of tune with social conditions (which I suspect it will be), and we are to agree with Propositions 3 to 6, which tend to keep us on the narrow track of the status quo,

then curriculum development will also be out of step with social conditions and therefore, according to this statement, should not be started.

If, as Dr. Burkman says in his concluding remarks, most of the world's *best* science curricula are found on library shelves, and not in classrooms then we should concentrate our efforts on getting them off the shelves, not on developing second or third rate programs just because they will sell.

This then is the problem which we as curriculum developers and the National Science Foundation face.

Shall we:

1. Work to develop curriculum programs which will show the way for the next decade?
2. Work to develop curriculum programs which will not be very innovative, but which will sell?
3. Concentrate our time, effort, and financial resources on getting the *best* science curricula of the past decade off the shelves and into the classrooms?

or

4. as we recall from some of the poorly written texts of the nineteen fifties; none of the above?

These are some of the problems with which I suggest that we wrestle with during the remainder of this session.

DISCUSSION

Highlights of the Reports of the Discussion Groups

- The updating process itself creates involvement. Get teachers and students to do it, but give them guidelines to minimize downgrading.
- How about unshelving some 'best' projects—update and modernize.
- How can information on results of research on how children learn be disseminated?
- Share information among research projects.
- Share information from research projects with curriculum projects.

- Develop a strategy for working with users (teachers, administrators, etc.)
- Share information among government agencies (NIE, NSF, USOE)
- Develop links with state departments of education.
- Collaborate with professional disseminators (industry, business, schools)
- Project developers should share 'tricks of the trade' possibly through a newsletter.
- Don't do a hard-sell job. Your product should meet a need in schools, and when they come to you, turn them on to the way your materials should meet their needs.
- Time is ripe for change. Teachers have to be more accountable and need new ideas. Students are looking for more electives.
- Involvement changes perspective.
- Use museums as a third road alternative to Burkman and Piel. Museums are—
  —excellent sites for teacher education
  —potential alternate school systems
  —potential solution to the problem of high cost of equipment.
- Some projects should be kept alive long enough for their influence to be felt gradually.
- Innovation alone is easy—you can easily make a better course. Dissemination alone is easy—go with what is most popular. The *hard* job is to disseminate a desirable innovation.
- Public desires are very conservative—the 3 R's and a biology course that will get my daughter into medical school.
- Should NSF and USOE support projects contrary to the public mood?
- Communicate with spot TV commercials.
- There must be continuous linkage between the developer and the user.
- If you don't get the program into the school, the change will not be made. The schools may change the program, but you may like what the school did better than what you did.
- If a product has good characteristics the public will find and adopt it.

NEW DIRECTIONS

NEW DIRECTIONS

The meeting culminated with discussions of future needs and opportunities in pre-college science education. The discussions centered on exchanging ideas and sharing views on science education for the future. As Dr. Raymond Hannapel, NSF, who chaired the final panel session, put it, the discussions provided an opportunity for "raising our collective consciousness as to what some of those [future] opportunities might be."

The discussions of the future started in small groups and continued in a final plenary session at which a representative of each group served as a member of a panel. Some points that had been considered in earlier sessions of the meeting were discussed again. However, a number of new themes emerged. The new themes related mainly to the changing nature of schools and of children's educational experiences.

> The school child of the seventies, as contrasted to the child of fifty years ago, is rich in information but poor in experience. Schools need to take this into account—capitalizing on the child's store of information and providing rich experiences for him. In using experientially-rich facilities within the community, one should start off with the assumption that the child can take active responsibility for his own education. As alternative educational resources are developed within the community, one of the roles of schools and educators could be to

orchestrate for the students the use of these various facilities.

Schools are changing. Curriculum developers in the '60s were reasonably confident that they knew what a school was and what schooling was. They could design a curriculum package, and by changing the set of instructional materials, they could change the instructional experience of the students.—In the 70's curriculum developers can no longer make such assumptions. Equal opportunity programs, special programs for the disadvantaged, multilingual programs, and so on, are probably having as much or greater impact on schooling as are the curriculum developers.

Educational effectiveness seems to come in the following order: first the family, then the neighborhood, then the mass media, and finally the school. Curriculum developers in the future should be concerned with more out-of-school educational experiences—with more alternatives to the classroom.

There are many reasons why schools are not necessarily the best places, and certainly not the only places, where students can have an effective introduction to science. More emphasis should be given to alternatives to the classroom.

Museums can provide rich educational experiences for children. They can be designed to provide a variety of individual and school and non-school group experiences. They can provide experiences that schools find impossible or too expensive to provide. They can be used for interdisciplinary activities, for example, weaving together studies of perception, optics, and wave motion and relating them to the study of art.

Because the field of education is in great turmoil, it is important that support of curriculum development in the future include support for some high-risk, pioneering programs so that we may be prepared with highly

innovative materials as new directions and perspectives in education emerge.

There is a need for financial support of studies on learning and teaching, since there is some concern today that perhaps the laws of learning are not generalizable across all subject fields and across all disciplines.

Teachers are going to need some special kinds of training that are different from those they have been getting up to this time. Much inservice education is going to be necessary. Very little study has yet been made as to what should constitute these new programs.

There is a need for regional science centers to serve a training function for teachers, a distribution function, and an assessment function of what is actually going on in schools. That kind of information is not very well known at the present time.

Teachers and teacher educators are not sufficiently informed about current science curriculum projects. There is a need to improve information delivery systems through regional science centers, educational extension agents, and ads on commercial and educational TV. Saturday morning TV would be a useful medium to get information to students.

How in the world can alternatives in education be implemented if nobody knows that alternatives exist? Educational television, travelling science fairs, conferences and other modes should be used to inform the public about alternatives so that people will start to ask, "Why don't we have those things in our schools?"

Look back to seek guidance for the future. A study might be commissioned to look at the whole science curriculum effort for the past 20 years to see what the impact of individual projects has been on the schools, and even more important, what the impact has been on commercial publishers' programs. Probably new ideas developed

in the curriculum projects have seeped into other programs.

Some very big new programs have not been widely used. A study might be made to determine the reasons some programs were adopted and others not.

Curriculum developers need to have a continuing exchange of information and ideas. Communication through newsletters and periodic meetings can stimulate curriculum innovation.

Appendix

PREPARED PAPERS
AND RESPONSES

AGENDA

PARTICIPANTS

CONFERENCE EVALUATION

PAPERS AND RESPONSES

Science, Schooling, and Society: The Search for an Integrated Curriculum

Peter B. Dow

The topic for this meeting "The Challenge of Developing an Interdisciplinary Curriculum," focuses our attention on one of the most persistent problems that educators face: the fragmentation of knowledge. It is not a new concern. Alfred North Whitehead, writing in 1912, inveighed against what he called "the fatal disconnection which kills the vitality of our modern curriculum." Said Whitehead:

> There is only one subject-matter for education and that is Life in all its manifestations. Instead of this single unity we offer children—Algebra, from which nothing follows; Geometry, from which nothing follows; Science, from which nothing follows; History, from which nothing follows; a couple of languages, never mastered; and lastly, most dreary of all, literature, represented by plays of Shakespeare, with philological notes and short analyses of plot and character to be in substance committed to memory. Can such a list be said to represent Life, as it is known in the midst of the living of it? The best that can be said of it is, that it is a rapid table of contents which a deity might run over in his mind while he was thinking of creating a world, and had not yet determined how to put it together.[1]

[1]Whitehead, Alfred North. **The Aims of Education and Other Essays.** The MacMillan Company. New York, 1929. pp. 10-11.

What would Whitehead think if he could examine our curriculum today? I suspect he would be further dismayed. In an age that is generating new knowledge at an increasingly rapid rate, we are adding endlessly to the list of available subjects while neglecting to ask what organizing ideas and principles give meaning to the academic quest. A glance at any college catalogue quickly reveals that we have allowed this growth to spread until it threatens to destroy any unified conception of a liberal education. The symbol of this disintegration is the modern multiversity, the knowledge factory that offers everything but espouses no unified conception of an educated human being and no coherent vision for the future of mankind.

It may be useful at this point, to remind ourselves of the historic tradition upon which our conception of a liberal education rests. From the beginning Americans have equated education with the preservation and improvement of society. Thomas Jefferson eloquently expressed this view in a letter to Joseph Willard, President of Harvard College, in 1789:

> It is for such institutions as that over which you preside so worthily, Sir, to do justice to our country, its productions, and its genius. It is the work to which the young men, whom you are forming, should lay their hands. We have spent the prime of our lives in procuring them the precious blessing of liberty. Let them spend their lives in showing that it is the great parent of science and of virtue; and that a nation will be great in both always in proportion as it is free.[2]

Underlying Jefferson's commitment to education was the conviction that a free society must promote the liberal education of all its citizens, and that those citizens in turn will, through the cultivation of intellect, virtue, and a love of liberty, perpetuate the free society.

Half a century later another famous spokesman for the American educational ideal, Horace Mann, sought to extend the Jeffersonian vision of the relationship of education to society when he took over responsibility for the Common Schools of Massachusetts. Sacrificing a brilliant law career to become secretary to the newly formed State Board of Education, Mann remarked, "I have abandoned jurisprudence, and betaken myself to the larger sphere of mind and morals."[3] Knowledge alone was not enough, in Mann's

[2]Lee, Gordon C. ed. **Crusade Against Ignorance: Thomas Jefferson on Education.** Bureau of Publications, Teacher's College. Columbia University, 1961. p. 19.

[3]Cremin. Lawrence, ed. **Horace Mann: The Republic and the School.** Bureau of Publications, Teacher's College. Columbia University. New York, 1957. p. 3.

view, because it could be used for both good and evil. To remedy this, he proposed Common Schools where children of all backgrounds learned together and academic achievement was subordinated to the promotion of human values. "Never will wisdom preside in the halls of legislation and its profound utterances be recorded on the pages of the statute book until the Common Schools shall create a more farseeing intelligence and a purer morality than has ever existed among the communities of men," he said.[4] Such a faith in the power of public education to instill civic virtue should give us pause in the current political climate. How inadequately we educators have performed our task!

Who speaks for the aims of education today? Our voices seem timid when compared to our forebears, and are easily drowned out by the demand for accountability and efficiency, the quantitative values of a technological age. We have to look beyond our borders to men like Ivan Illich and Paulo Friere to find men today who can articulate a moral imperative upon which to construct a socially responsible curriculum. Our most inspiring educational philosopher is still John Dewey, who launched a quiet revolution in American education with his Pedagogic Creed set down in 1897:

> I believe that all education proceeds by the participation of the individual in the social consciousness of the race. This process begins unconsciously almost at birth, and is continually shaping the individual's powers, saturating his consciousness, forming his habits, training his ideas, and arousing his feelings and emotions. Through this unconscious education the individual gradually comes to share in the intellectual and moral resources which humanity has succeeded in getting together. He becomes an inheritor of the funded capital of civilization. The most formal and technical education in the world cannot safely depart from this general process. It can only organize it or differentiate it in some particular direction.[5]

Here Dewey reiterates the underlying assumption that has governed the evolution of American education since Jefferson's time: the training of mind and the shaping of character cannot be divorced from a consideration of the values of the society of which the educational system is a fundamental part. Only when we can properly frame the social and moral imperatives of our own time will we be able to solve the problem of the integrated curriculum.

Having said all this, let us now consider where we are. Those of us who have participated in the curriculum movement over the

[4]Ibid. p. 26.

[5]Dworkin, Martin S. **Dewey on Education.** Bureau of Publications, Teacher's College. Columbia University. New York, 1959. p. 19-20.

past decade have seen a profound change in the orientation of curriculum makers during this period. In the wave of science-based curriculum projects that followed the launching of Sputnik in 1957 there was little explicit attention given to the social purposes of instruction. The emphasis in those years was on the transmission of knowledge in the most economical form through the identification of central ideas, and on the invention of pedagogical techniques that supported and reinforced the child's natural curiosity and desire to learn. One of the most influential thinkers of the period, Jean Piaget, turned the attention of curriculum-makers almost exclusively, to the child's processes of cognitive growth, and to individual differences in learning style. Another, Jerome Bruner, wrote an immensely popular book, **The Process of Education**, that stressed the most effective ways of organizing the transmission of knowledge while making only passing reference to the social consequences of instruction.

No one during those years talked much about the emergence of the child as a social creature. The failure of these early reformers to consider the moral dimension of learning has left us with some troubling problems. While the curriculum leaders of the sixties were enormously effective in extending the scope of the curriculum to include many new areas of knowledge, and were equally inventive in developing new pedagogical approaches and techniques, they neglected to evolve a unifying social purpose for their reforms. Thus, inadvertently, they contributed to the curriculum fragmentation that we face today. The growing disaffection of both high school and college students with a curriculum that fails to relate learning to real-life problems is a measure of how far we still must go to close the gap between curriculum development and social need.

Now we are in the midst of a second wave of curriculum reform that is attempting to respond to these new demands. Where physics teachers were once content to enliven the teaching of their subject by having students 'do physics' rather than read about it, now they are striving to help students 'do something useful with physics,' like unscramble a traffic jam or design a better security system. Or where before it was enough to examine pond water to expose the mysteries of the ecosystem, now students are asked to apply such knowledge to solve pollution problems or to debate questions of environmental planning. Even in the social studies classroom, where it used to be sufficient to contrast comparative political structures or explore the diversity of cul-

tural patterning, teachers are now pressed to think about how new knowledge about human behavior can be used to construct a more liveable world. In these new efforts, we can begin to discover the broad outlines of an approach to curriculum-making that relates the teaching of 'disciplines' to the needs of society. Such an approach could chart the path to a more integrated curriculum.

Both the excitement and the magnitude of the task we face is perhaps best illustrated by examining a specific case. In 1970 a group of scholars, teachers and curriculum writers assembled at Education Development Center in Cambridge, Massachusetts to begin designing an interdisciplinary social studies course for high school students entitled **Exploring Human Nature.** Our intent, broadly speaking, was to create a course that would draw upon both natural and social science disciplines—particularly biology, anthropology, psychology, and sociology—to help students understand, on the basis of the best current scientific thinking on the subject, what it means to be a human being. In particular, we hoped to devise a way to help adolescents understand themselves as individuals passing through a particularly significant stage of the human life cycle, as participants in a society that has distinctive norms and values, and as members of a species having some generalizable traits that are a product of a long evolutionary history. Implicit in our approach, and in our desire to design this course, was the assumption that knowledge of human behavior was an important psychological anchor for adolescents growing up in a world of flux and rapid social change. We hoped that such a course would provide students with an appreciation of their own psychological uniqueness, an awareness of the kinship they share with other members of their own culture, and an understanding of the biological and behavioral characteristics that unite the human race as a whole. Like Leon Eisenberg, we believe that an enlarged sense of human identity can increase our potential as human beings—can help us to become more fully human.

It did not take us long to discover that no academic discipline within the natural or social sciences was adequate to cope with the questions we wanted to raise. As Irven DeVore, one of the principle developers of the course, is fond of pointing out, most of the interesting issues in the study of human behavior fall *between* the disciplines. Take a simple behavior such as a two-year-old speaking, for example. To begin to understand so basic a behavior—one would have to consult at least half a dozen scholars: a physiologist to find out about the anatomy of vocalization; a

biologist to learn about differences between verbal and non-verbal communication; a child-development specialist to understand stages of development; a social-psychologist to study the process of acquisition; an anthropologist to examine cultural differences; a linguist to explore matters of syntax and structure; and so forth. Clearly, the university was organized into a set of arbitrary departments that bore little relationship to the problems we wanted to discuss.

Having found the conventional disciplines to be of marginal usefulness to us in framing the problems and devising the conceptual framework for our course, we proceeded to organize materials around issues that appeared to be interesting to students: child-rearing practices, male-female differences, love and affection, expressions of fear and anger, parent-offspring conflict, etc. and then sought support from different departments of the university to clarify how we were approaching these questions. It soon became apparent that academics from different disciplines often use different words to discuss the same or nearly the same phenomena, and that these words are invested with quite different associations and meanings. A biologist, for example, speaks of 'bonding' when examining relationships between male and female or between parent and offspring, while a psychologist may use words like 'love' or 'attachment.' Similarly a psychologist talks of 'anxiety' and 'hostility' when discussing conflict between individuals, while an anthropologist is inclined to use terms like 'dominance' and 'aggression.' Accomodating these differences in usage is no easy matter for they often reflect fundamentally different viewpoints about the way a specific behavior can be explained.

Still another problem that has plagued our work was the discovery that the 'disciplines' represented not only separate languages and tools of analysis, but also drew upon bodies of data that did not overlap. Evolutionary biologists are free to do their work unchallanged so long as they confine their investigations to animal behavior, but let them not intrude upon the study of human beings. Anthropologists are safe while examining preliterate cultures, but suspect when they put their tools to work on recorded history. Psychologists may examine interpersonal behavior, but let them not extrapolate their findings to a theory of society. So long as the academy supports the autonomy of its departments and fails to encourage cross-disciplinary study of similar phenomena, aca-

demics from different intellectual traditions will be deprived of the opportunity to learn from each other. Needless to say, both scholarship and the cause of general education will be impoverished as a result.

But the deepest and perhaps most troubling problem we have encountered has been the struggle to accomodate the differences between the natural and social sciences. The cleavages between these two areas of knowledge run so deep as to constitute, in extreme cases, fundamentally different points of view regarding the nature of man. Our encounter with these differences has emerged from our effort to combine perspectives from biology with insights drawn from anthropology, psychology, and sociology. At the heart of these differences seems to be conflicting opinions as to whether human behavior can be understood with reference to the biological process of evolution by natural selection. On one side, some social scientists go so far as to assert that cultural evolution proceeds quite independent of biological factors. An extreme exponent of this position is Leslie White. In his book, **Evolution of Culture**, he puts it this way:

> Although culture is produced and perpetuated only by the human species and therefore has its origin and basis in the biological makeup of man, in its relation to human beings after it has come into existence and become established as a tradition, culture exists and behaves and is related to man as if it were non-biological in character. . . . (we would not) be aided in our study of culture in the slightest by taking the human organism into consideration. . . . the biological factor is irrelevant, and consequently it should be disregarded.[6]

On the other side, in **The Territorial Imperative**, Robert Ardrey proclaims the primacy of biological forces in understanding human behavior:

> I submit that the continuity of human evolution from the world of the animal to the world of man ensures that a human group in possession of a social territory will behave according to the laws of the territorial principle. What we call patriotism, in other words, is a calculable force which, released by a predictable situation, will animate man in a manner no different from other territorial species.[7]

[6]As quoted in: Smuts, Barbara D. **The Crossdisciplinary Aspects of Exploring Human Nature.** Sources for Teachers, ed. by George Goethals. Education Development Center, 1974. p. 108.

[7]Ibid. p. 109.

For our purposes, neither view is satisfactory for it is precisely in the *interaction* of biology and culture that some of the most interesting insights into human behavior emerge. Take weeping, for example. Biology tells us that the female hormone estrogen predisposes a person to cry, and, not surprisingly, it turns out that women in all cultures, so far as we know, are inclined to weep more than men. At the same time, we know that different cultures develop different expectations about when weeping is appropriate, some tending toward stoicism, others inclining toward emotionally expressive behavior. This can lead to wide variations in weeping behavior among men and women. Men in some cultures are likely to weep more than women in other cultures. Both biological and environmental influences seem equally important in this case.

Perhaps an even more interesting example for our purposes is what interdisciplinary studies are now revealing about the nature of learning. Stimulous response psychology has told us for years that rats and, presumably, human beings are shaped almost entirely by their responses to negative and positive stimulae within the environment: they act to seek pleasure and avoid pain, and can be taught or 'conditioned' to do anything, simply by careful manipulation of the external stimulae. Recent experiments, however, reveal that the rats can be taught to avoid food of a certain flavor when experiencing artifically induced nausea several hours after eating, but that they never learn to associate food of a particular size and shape with delayed sickness. This suggests that the rat brain is not an undifferentiated organism shaped entirely by the external environment, but it is predisposed by natural selection to react differently to different external stimulae. The rats' response is logical in this case, because poison is more likely to be associated with taste than with size in the real world.[8]

Extrapolating to human beings, it is reasonable to postulate that we, too, are predisposed by our evolutionary past to respond differentially to environmental forces, and are not simply the passive recipients of stimulous-response shaping. Boys, for example, are inclined to engage in rough and tumble play in all cultures, regardless of efforts made to extinguish it, and, as every junior high school teacher knows, they will often endure considerable punishment without changing their behavior. Similarly, newborn infants, as John Bowlby has demonstrated, can elicit differ-

[8]Seligman, Martin, E. P. & Hager, Joanne L. (ed.). **Biological Boundaries of Learning.** Appleton-Century-Crofts. Meredith Corporation. New York, 1972. pp. 10-14.

ent care-taking behaviors from their mothers through different types of crying that appear to have an evolutionary origin. This suggests that Dr. Spock may advise an American woman to behave quite differently toward her baby than a bushman mother does, but it is *not* likely to alter the behavior of the baby very much.[9]

Still another example of the power of combining insights from both biology and social science in an examination of human behavior is in the study of pair bonding and the evolution of the human family. While anthropology exposes us to the diversity of forms that family structure takes around the world—monogomy, polygany, polyandry, etc.—social science alone cannot explain the persistence of the family as the fundamental unit of society, despite profound changes in culture and despite numerous experiments designed to replace the family with other forms of social organization. Biology reframes the question and asks, "Why should Natural Selection favor pair bonding between human males and females and the investment of energy by males in the care of their own offspring?" Even chimpanzee males, our closest primate relatives, have no lasting pair bond with females, and make little or no investment in the care of the young. Why should human beings share with most species of birds and a mere five percent of all species on earth the unique adaptation of prolonged pair bonding between male and female—the basis of the human family?

By asking the question in this way we can see how biology informs the social sciences. Evolutionary theory can help us to see how over five million years of human evolution selection pressures have favored a pair bond between male and female that facilitates economic diversity—division of labor for hunting and gathering, for example—and ensures maximum care and protection of the young. Clearly, those males who were predisposed to stay with females had greater reproductive success, and it was their genes that survived. What biology helps us to see is that underlying the surface diversity of cultural patterning lies a set of biological forces that interact with culture to produce particular behaviors. Thus, by combining the insights of biology with those of anthropology we are able to provide students with a more comprehensive way of thinking about human nature than any single discipline allows us.

I hope these examples are sufficient to suggest the excitement and the freshness of viewpoint that can emerge from a deliberate

[9]Much of this material is drawn from the Smuts article cited above.

effort to examine human behavior from new and multiple perspectives. I am sure that many of you have experienced a similar exhilaration in employing the interdisciplinary approach to other areas of the curriculum that I know less well. I suspect one of the most fruitful fields for interdisciplinary curriculum work is in environmental studies. Here the natural and social sciences can interact to explain the workings of the ecosphere, and to frame the crucial issues of our relationship to the environment that must be resolved if human society as we know it is to survive. Books like Barry Commoner's **The Closing Circle** demonstrate the need for an interdisciplinary approach to understand our ecological problems, and the tragic results of a fragmented one. His account of the death of Lake Erie, for example, is a disturbing demonstration of the failure of modern science to cope with real world problems. Commoner blames this failure on the isolation of the disciplines and in words reminiscent of Whitehead, criticizes the way we teach:

> Life, as we live it, is not encompassed by a single academic discipline. Real problems that touch our lives and impinge on what we value rarely fit into the neat categories of the college catalogue, such as physical chemistry, nuclear physics, or molecular biology. . . . To encompass in our minds the terrifying deterioration of our cities, we need to know not only the principles of economics, architecture, and social planning, but also the physics and chemistry of the air, the biology of water systems, and the ecology of the domestic rat and the cockroach. In a word, we need to understand science and technology that is relevant to the human condition.[10]

So where are we? I have tried to set forth several propositions that I hope will guide our discussions of the development of interdisciplinary approaches to curriculum-making. First, I have argued that curriculum design must today, as it always has, spring from some vision for the society that we want our children's children to inhabit. Historically, that vision has always been stated in moral terms. For Thomas Jefferson it was the preservation of freedom, for Horace Mann it was ethical training, for John Dewey it was participation in the consciousness of the race, and for ourselves, although we don't quite know how to formulate it yet, I suspect that it is caring for our natural environment and the precious human beings that inhabit it.

Second, I have attempted to point out that while philosophers have always stated the aims of education in moral and human

[10]Op. cit. p. 189.

terms, there seems to be a persistent tendency within the academic world to depart from these larger goals in the pursuit of narrow and specialized ends that take the search for human understanding away from the problems of the turbulent world. While there are those who may justify this in pursuit of some higher truth, today, with the escalation of human and environmental problems increasing at exponential rates, we need more than ever an educational system that places learning in the service of human beings. Can the pursuit of knowledge without regard for its social consequences threaten the stability of society as we know it? Can technological advancement create an uninhabitable environment? For the first time we must ask such questions.

Finally, I have sought to demonstrate that an interdisciplinary curriculum can be built that strives to address real life problems, but it can be achieved only through a willingness to grapple with some of the tough intellectual issues that our fragmented academic world has imposed upon us. The disciplines, as we know them, are not likely to go away soon just because we pronounce them inadequate to our task. Nor will we easily resolve the conceptual issues that divide them. But by asserting leadership ourselves, by framing problems that engage students and have social relevance, and by enticing the best minds in academia to join us in the search for more powerful ways of thinking about the central issues of modern life, we can begin to reconstruct the curriculum in the schools in ways that tailor the search for knowledge to the pursuit of human needs.

It will take all the courage and energy we can summon to bring about the reforms of which we speak. Scholars and school teachers alike are trapped in a conventional pattern of curriculum organization that would bend us to its will. And even when we have managed to solve the problem of designing the interdisciplinary curriculum, I suspect our troubles will have only begun. We will still have the 'gatekeepers' in the schools to face. Recently, I examined the materials of a national curriculum project that has gone further than most in developing interdisciplinary approaches to real world problems. The designers of this program have managed to invent ways to integrate the teaching of mathematics, simple engineering, many of the usual topics treated in elementary science, environmental studies, and even aspects of geography and the social studies into a series of units that engage students across the elementary grades in solving problems such as the design of a play area, or making a community more habitable for

people on bicycles, or studying the traffic patterns at a dangerous intersection. Children, by all accounts, are responding with great enthusiasm to these activities, and acquiring a variety of problem-solving skills: measuring, estimating, computing averages, quantifying alternatives, analyzing data, making decisions. Teachers of the program are enthusiastic about the success of this approach. And what is one of the project's most persistent criticisms? Curriculum supervisors are skeptical because they cannot identify what *disciplines* the children are studying.

But we must take heart, and remember that it is our own humanity and that of our students that we seek to rescue from those who would wrest it from us and force us to reduce the marvelous complexity of life to a set of sterile categories. Until we do so, we only have ourselves to blame for the dehumanization of our educational system, a system that simply mirrors the misplaced priorities of our technocratic age. Perhaps we can draw inspiration from the words of Archibald MacLeish who put our problem well in an article for the **Saturday Review** a few years back:

> After Hiroshima it was obvious that the loyalty of science was not to humanity but to truth—its own truth—and the law of science was not the law of the good—what humanity thinks of as good, meaning moral, decent, humane—but the law of the possible. What it is possible for science to know science must know, what it is possible to do technology will have done. . . . The frustration—and it is a real and debasing frustration—in which we are mired today will not leave us until we believe in ourselves again, assume again the mastery of our lives, the management of our means.[11]

[11]Ibid. p. 180-181.

Integrative Curricula

Response to Peter Dow's, "Science, Schooling and Society: The Search For An Integrated Curriculum"

James T. Robinson

I will organize my remarks around three questions that seem to be implicit in Peter's paper:

—What are the problems we are trying to solve?

—Why do we think integrated or interdisciplinary curricula will contribute to their resolution?

—Will such curricula work?

The problems I find in Peter's presentation that need to be solved are as follows. First, we have a fragmentation of knowledge, with its attendant specialization, its lack of direct relevance to real-world problems, and the gaps that are left unattended. A second problem raised was how to relate the teaching of the disciplines to the needs of society. A third issue was the disaffection of students with a curriculum that fails to relate to real life. Fourth, the failure to consider the social dimensions of learning, and finally the issue of how we can get really different curricula by the 'gatekeepers' and into the classroom.

In addition to these problems, Peter raised several that relate to the development of integrative or interdisciplinary curricula. I will not discuss these issues. I agree with them and feel that they need deliberation in our group meetings. That integrative curricula can contribute to the resolution of the problems to be asked is explicitly stated in Peter's presentation; for he urges that we need to "properly frame the moral imperatives to solve the problems of such curricula."

I think that there are additional problems that need to be considered. Integrative curricula may provide a necessary, but not sufficient effort for their resolution.

Student disaffection is an issue that needs more elaboration, in my judgment. What students, at what age levels are disaffected by what curricula, under what conditions, and for what reasons? We need much more precise information than is currently available on this problem to help determine curriculum policy. We also need to decide if we care about students reaction to curricula. We haven't always considered it worth our attention. I agree that the problem is real and important. What I find, however, is that the ideologies of curriculum developers usually have more to do

with proposals for solving the problem than does information about the problem. I would urge that any single solution, including integrated curricula, be reviewed very carefully before it is applied to all curricula, for all students, at all levels—kindergarten through graduate school.

I would like to reformulate the student disaffection question to ask, "how does one design a curriculum so it will have personal meaning for each student?" This question may need to be answered in different ways for different students in different curriculum areas. Peter suggests that integrated curricula can contribute to solving this problem. He suggests that integrative concepts be presented to students in more meaningful ways than can concepts from the separate disciplines. However, he seems to accept the same overall goal for both kinds of curricula. This goal is the transmission of the culture to the next generation. Meaning, in terms of each student, will be enhanced by such curricula; the fragmentation of knowledge will be reduced; issues that now fall between the disciplines can be considered; and integrated curricula can be more effectively related to the needs of society and the real-life of the student.

We can now ask: Will it work? Let me suggest that it has been tried. Biology, as a high school course, had its origins in the decade 1900-1910 (Hurd, 1961). Hurd reports that "by 1910, only 1.1 percent of all high school students were enrolled in the course."

When I started teaching high school biology my school offered botany, zoology, and physiology. It was not until 1956 that a beginning and advanced course in biology became the life sciences offering. Many of the early texts in high school biology were organized in groups of practical problems, problems designed to be of interest to high school students. This very attempt to solve the student disaffection problems of the 1920's and 1930's in curricula was paralleled by the formalization of interdisciplinary biology into biology, the discipline. When biologists looked at high school curriculum materials in the late 1950's they found the books and labs to be obsolete in terms of the discipline. Their correction of this sad state of affairs, and it was badly in need of correction, was to both up-date the content and to organize the curriculum in terms of formalisms that made sense to academic biologists—the structure of the discipline. This kind of organization also made sense to some students, but many found that the academically organized integrated biology curriculum was irrelevant to their real lives. An interdisciplinary structure was not adequate to resolve the student disaffection problem.

The issue I am raising is that I think interdisciplinary structures are necessary, but are not in themselves sufficient elements to contribute to the resolution of the problems Peter raised. We also need to give serious consideration to how the curriculum should be organized, what are to be its essential means, and what are its desired ends. And, I believe, that the question may require different answers for students at different levels within the educational system.

I suggest that we not consider our job done with the invention of new integrative concepts. We need to invent alternatives to an academic organization for integrative curricula, alternatives that may vary considerably from kindergarten to graduate school.

I have raised the issue of means and ends as a problem to be considered. Redefining the broad areas of knowledge and transmitting them to students is implicit in Peter's presentation, if applied broadly. Kohlberg and Mayer (1972) have recently argued that human development, as distinct from cultural transmission, should be the proper aim of education. Piaget (1973) in his recently translated book, **To Understand Is To Invent**, argues that this means—traditional presentation of information—reduces " . . . education to simple instruction, it becomes only a question of 'furnishing' or nourishing capabilities that are already formed and not of forming them." Piaget's position is that logical thinking is created through organism-environment interaction (it is not already there), a process that seems to me to be quite different from a student appropriating someone else's explanations. Piaget emphasizes this point by stating that "in order to understand basic phenomena through deductive reasoning and the data of experience, the child must pass through a certain number of stages characterized by ideas which will later be judged erroneous, but which appear necessary in order to reach final correct solutions." (Piaget, 1973, p. 21) To me this suggests that the importance of the child's constructing his own explanations of objects and events is an important curricular means. The ends, for some period of time, would be explanations that would be divergent from the best simplified scientific explanations.

Interdisciplinary curricula that use presentation of the formalisms as a means may not resolve the problem of personal meaning and student disaffection. Interdisciplinary curricula that are organized in ways not meaningful to students may not resolve these problems. Peter has given several examples of the potential effectiveness of a problem organization, when the problems make sense to the target student group.

A final question I would raise relates to how we attack the problem of fragmentation. Most efforts that I am aware of have attacked the problem by developing curricula for a single subject for one or several years of a student's experience. Would it not be opportune to attack the problem by developing a full program, say for fifth graders or for eighth graders?

I have now raised several issues in addition to those Peter raised that I feel must be considered in a search for integrated curricula that will contribute to resolving the problems he proposed that we need to solve.

—Who are the students for whom we are designing the curriculum, what are their interests, their concerns, and their range of competencies?

—Are integrated curricula appropriate for all of them at all educational levels?

—How should integrated curricula be organized?

—What ends do we have in view and what means are appropriate for their attainment?

—Should we try to solve some problems through different curriculum development efforts, such as developing curricula for a complete grade level?

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Some Thoughts Concerning Evaluation and Curriculum Development

Robert Karplus

The basic ingredients of evaluation are an observation and a judgment. In an informal way, therefore, evaluation is a part of everyone's daily professional and home life. Because of its pervasiveness—all decision-making involves evaluation in some way—the term is applied under many differing conditions and to many kinds of activities. One can, for instance, speak of the evaluation of individual students' progress in an educational program, or one can speak of the progress of a group of students after a statistical treatment of data from many individuals. The classroom teacher, of course, is concerned with the former. The curriculum specialist, however, usually is more interested in the latter, because he is aiming his products at many students and must depend on the classroom teacher to adapt them to the unique needs of individuals. Because school administrators and the general public also are largely concerned with data from groups of students, one might think that evaluation techniques used by them might serve the needs of the curriculum specialist. And yet, the standardized tests that are the most widely used evaluation device of student achievement are of no value, or possibly of negative value, because they are rarely related to relevant curricular content, require a great deal of reading, and discourage thoughtfulness. What the scores do mean I hesitate to define.

Now that I have limited the general area of my further discussion, I shall briefly touch on what is probably the most controversial aspect of evaluation: the value system within which the judgment is made. One approach is to identify the educational objectives, perhaps in behavioral terms, and then to use students' average progress toward the achievement of these objectives as the yardstick in retaining or revising an activity, pursuing teacher education with certain emphases, and/or taking other indicated steps. I consider this procedure too limited, because a teaching program has so many cognitive and affective aspects that a complete list of objectives can never be constructed. Still, some objectives may be appropriate, and their attainment can give a partial measure of an activity's effectiveness.

A second approach to defining the value system is through extensive discussion and collaboration among the members of the

development team, until an implicit operating agreement is reached. Decker Walker has called the result of this process a 'platform'. It is never stated explicitly, but rather represents an intuitive sharing of values. Even though a platform can encompass many more aspects of a teaching program than can a list of objectives, it cannot readily be communicated to outsiders and it is likely to have some residual ambiguities even for the insiders. Nevertheless, it would appear to complement the objectives approach and I would recommend a combination of both.

Just what role objectives and platform would play should depend on the course being developed. If it is to have certain common outcomes for all students, then these would lead to the list of objectives. At the same time the development team's 'platform' would provide for decision-making in areas outside the objectives. My personal preference is to minimize the common basic outcomes and therefore the list of objectives, and to maximize the freedom for individuals to develop and pursue their own objectives.

With the value system determined explicitly, implicitly, or in a combined way, the evaluator can take the next step. According to Michael Scriven, he has to decide on the function of the evaluation in relation to the development process. If the results of evaluation are primarily used to improve the course while it is under construction, we are dealing with 'formative' evaluation. It is then often more important to identify student difficulties and track down their origin, than it is to measure average achievement. After all, knowing that there are difficulties—and they never go away—is not useful to the developer unless he has some clues as to how to cope with them. Here the usual testing approach is every limited in value. Rather, interviews of students, conversations with teachers, and observations in the classroom are likely to be much more informative. Especially to be considered is the likelihood that part of the platform—perhaps mathematical concepts, perhaps critical thinking—has not been understood by either teachers or students, so that only members of the development team can really identify successes or failures. I would urge that all members of the development team contribute to formative evaluation both by teaching their own activities and by observing teaching by their colleagues as well as regular teachers.

Scriven contrasts formative evaluation with 'summative' evaluation, a process that assesses the overall impact and value of a new course after it has been completed, with no immediate prospect that the results be used to revise the program. This seems like a

very ambitious task to me. For one thing, it really calls for defining values outside those selected by the developers, but including all or some of them, and this reopens the first task of value setting. To sidestep this problem, it has been suggested that summative evaluation be merely a fact-finding activity, to be interpreted by everyone according to his own values, or that it be 'goalfree' (a term of Scriven's) in that the evaluator applies his own value system rather than that of the developers.

Commenting on the usual 'experimental design' involving an experimental and control group, with pre- and post-tests, Malcolm Parlett has likened it to the testing procedure used in medicine and agriculture, when a new drug or pesticide has to be evaluated. He calls it the 'agricultural paradigm', and considers it to have very limited value when applied in educational situations with their vastly greater range of variables and the virtually impossibility of controlling or even being aware of all relevant ones. He therefore recommends 'illuminative evaluation', a more clinical procedure in which many aspects of the experimental program are probed in depth by means of observations, interviews, as well as written tests and documents.

One matter closely related to the type of information gathered for evaluative purposes is whether the course goals are short-term or long-term influences. Most skill development, such as typing or shorthand, can be viewed as a short-term objective, with a certain expected accomplishment at the end of the course. If the student has a real need for the skills and therefore applies them frequently thereafter, he is likely to improve in efficiency; if he does not use the skill, he will forget it and may have to re-learn it at a later time. Many parts of a general education, such as comprises most of the schooling for pre-college students, are not closely related to their current needs and therefore are not likely to lead to spontaneous activity that maintains, much less deepens, the knowledge and understandings that are to be acquired. The learning outcomes immediately following the conclusion of a particular course may therefore be less important than the long-term consequences for the individual five or ten years later. Illuminative evaluation is geared to identify both short-term outcomes and potential long-term influences, though the lack of educational theory makes it impossible to extrapolate reliably into the future.

Another way of looking at the long-term/short-term dichotomy is to consider evaluation of the educational process versus eval-

uation of the short-term educational outcomes. I believe that the teacher's attitude toward the students, the students' opportunities to express their own ideas, requirements for intellectual conformity rather than the encouragement of individual opinions, and other aspects of the education process have important long-term consequences. This is an educational hypothesis that leads me to place more faith in illuminative evaluation than in the agricultural paradigm. How do you feel on this matter? The fact that studies like the Coleman Report have not succeeded in identifying any school-related factors that substantially influence the impact of education, only makes me conclude that they have not asked the right questions.

I shall now add to these dichotomies by comparing 'public' and 'private' evaluation. Public evaluation is an activity whose results are to be used by a professional group of concerned individuals and must therefore be communicated, usually through journal publication, to anyone who cares to acquaint himself with the findings. Private evaluation is intended for the use of the evaluator and his close professional associates. Its results are therefore communicated informally, with only implicit references to the shared values of the working group. Private evaluation is thus closely similar to the everyday evaluation I mentioned at the beginning of these comments, and it is, in my opinion, the vital component of successful curriculum development. I shall go further to claim that public evaluation, when viewed as an essential part of curriculum development effort, is likely to be counterproductive for three reasons: (1) it consumes valuable resources; (2) it highlights decisions that can be documented easily, regardless of their importance or merit; (3) it delays decisions until more than the minimum necessary evidence is assembled. In other words, I believe that all real decisions are based on private evaluation, and that public evaluation is an after-the-fact rationalization.

In conclusion, I should like to promote a couple of ideas that I have been developing during the last few years. One involves asking students not only to answer certain test questions, but also to explain or justify their answers. The original question might be a multiple choice item, a mathematical problem, a scientific prediction, or any other ordinary test item. The novel aspect is that the student's explanation or justification gives the evaluator insight into the student's understanding if the answer is correct, or into his misconception if it is incorrect. Of course, writing and

reading the additional material are time consuming, so that the number of test items has to be reduced when this technique is used. Another advantage of this kind of question, however, is that the students come to realize that answers have reasons.

The second idea is to pose some questions that do not uniquely define a problem situation. The student is asked first to evaluate the question and supply any information or conditions that may be needed to make the problem unique, and then to answer the question itself. Here also, the time needed for scoring is increased, and the scoring itself becomes more complex. Note that both of these ideas address themselves to the higher categories in Bloom's taxonomy.

Value Systems, Approaches and Accountability: A Reaction to Professor Karplus

H. Russell Cort, Jr.

My task is to react to Professor Karplus' thoughts and suggestions about evaluation in the service, or disservice, of curriculum development. By agreement, I will try to be provocative. It was such a wide ranging exposition that perhaps the first thing for me to do is to summarize what seem to be the main topics, and then the main implications. The following seem to be the main points made:

1. Evaluation, which involves an observation and a judgment, pervades all decision-making;
2. Standardized achievement tests are of no value (or of negative value) to curriculum specialists, since they are not directly related to specific curriculums;
3. Evaluation, even goal free evaluation, involves the application of a value system, and therein lies much contention. Nevertheless there are different ways of defining the value system—implicitly, explicitly, or some combination.
4. While the usual evaluation models are experimental (psychometric/agricultural paradigm) it might be more productive to pursue illuminative evaluation, using more clinical methods.
5. One can distinguish short-term or long-term objectives and effects, and also public and private evalution. Public evaluation is done for a concerned group other than the developers, teachers or whomever. Private evaluation, which is more like everyday evaluation, is informal and internal to a project.
6. Finally, there is something to be gained from asking students to explain their multiple choice answers, and one should pose somewhat ambiguous questions and ask students to evaluate them before answering them.

The thrust of all this seems to me to be that curriculum development projects should have their own internal evaluation processes; they should not be encumbered with outside (or by public) evaluation; and they should not be restricted to an experimental model routinely pumping out pre and post standardized test scores. If I have misrepresented the thrust of the paper, it may be that I am not privy to the platform from whence it was launched. I did have some difficulty getting a clear sense of where we were headed.

In considering these points from a different perspective—that is, as a researcher and evaluator rather than a curriculum specialist—I find myself in essential, unruffled agreement with some points, confused about the purpose of some points, and disturbed about the straw man quality of others.

Taking my own value system in hand, I should like to comment on several aspects of Karplus' propositions.

1. The problem of values.
2. The available tools for evaluation.
3. Finally,—accountability.

First, I quite agree that evaluation involves application or tacit involvement of a value system, and that it involves observations and judgments. Some years ago I found myself thinking that the issue of evaluation is not whether it is done or not. The issue is *how, by what rules of evidence,* and *according to whose criteria.* Values of course are always present and they affect what one observes, how one interprets, how one weighs factors in arriving at decisions, Precisely for this reason, I think, it is appropriate to have an outside person, especially in formative formulative evaluation, not inducted into the platform or sub-culture periodically review, audit, etc., to upset sets.

In some respects, evaluation can be viewed as a form of applied epistemology. The basic problem is to determine how you know whether something is so or not. One interesting application of this arises in the case of criterion-referenced tests in which the problem of deciding on a pass-fail criterion is really the problem of how much or what kind of evidence do you require tc decide that a student has mastered something. There are at least two, and possibly three, general criteria of mastery:

1. *Immediate retention,* as measured by an immediate performance defined as successful;
2. *Long-term retention* (how long term is long term?);
3. *Transfer or generalization.*

The first is frequently a criterion in a learning experiment. But the curriculum designer may, I think, be at least as interested, if not more so, in the latter two, given the first.

The point in the present context is that evaluation is in no small part a struggle to know whether something is so. Has this student mastered this concept? Has this material facilitated that learning? Is this teacher using this unit or material as intended? In this sense, evaluation is a process beset with the hazards, pitfalls and economic restrictions that beset any inquiry. The choices confronting both curriculum developer and evaluator (or curriculum developer as

evaluator) are not, I think, first of all results of differences in value systems. They are the results, purely and simply, of limited resources. My own experience in program or project evaluation is that the first and foremost problem is deciding (hopefully with the project staff if we are doing evaluation for a project) what questions are important to answer within the limits of time and resources. This is, of course, a values problem but not necessarily a problem of value conflict. I am tempted to hypothesize that the closer you get to the implementer (e.g., the teacher) the more questions the user would like to have answered. The value problem becomes more evident as you get down to considering what is worth knowing (evaluating) and how much is it worth.

The curriculum designer and, indeed, the teacher, face exactly the same decision problem (viz. deciding what is worth how much effort.) The teacher, for example, must trade-off amount of mastery desired against interest or motivation. If it turns out, according to some recent data,* that one level of mastery may enhance retention, but a slightly reduced level may enhance continuing interest in the subject. I would hope that evaluators would help clarify such choices, as well as choices of evaluation priorities, rather than to impose a set of priorities arbitrarily.

I don't want to belabor the values issues unduly here. However, two further points seem in order. I think the most practical problem evolving out of the values issues is not whether to use behavioral objectives, or to develop a metalanguage and sub-culture among the development team. Certainly from the evaluator's point of view the practical problem (especially in formative evaluation) is to determine users information needs. I have used from time to time the concept of an *information users needs assessment* as a device for focussing on the problem of credibility, acceptability and utility of evaluation information. An evaluation person, especially in a formative mode, needs to determine, obviously, not only who his audience is (and it may be a number of people in a number of position and agencies.) He also wants to know what are their various priorities with respect to questions and information, and what criteria of success and effectiveness do they have. Professor Karplus suggests that all real decisions are based on private evaluation (and that public evaluation is an after the fact rationalization.)

*Block, James H. Student Evaluation: Toward the setting of mastery performance standards. Paper presented at the annual meeting of the AERA, Chicago, Ill., April 4, 1972 (ED 065-605).

I think the public/private dichotomy is somewhat a straw man problem as used here. Private evaluation could be as rigorous in a scientific sense as public evaluation presumably is, and real decisions could be based explicitly on the results of such an evaluation.* The point is that one can be aware of disparities in values between evaluator and practitioner and take explicit steps to explicate underrlying assumptions and differences in values. One of the useful functions of evaluation may indeed be to reveal and clarify underlying values which have constrained the curriculum under development.

The second point I wanted to make about values, before turning to another issue, is that the developer of a curriculum may have a set of shared values about the materials developed, and indeed may be one of a set of judges about success or failure of it, in Karplus' terms. However, once the curriculum enters the public domain, it becomes subject to use and judgment according to value systems beyond the developers control. Perhaps a useful function of formative evaluation is to try to determine and bring to bear as wide a range of values as possible so that designers can decide what they want to do about some anticipated reactions.

I now want to turn to the image of evaluation that seems to me to come through in Professor Karplus' paper. It (evaluation) seems simplistic, trivial and possibly somewhat of a rip off on the one hand; and as natural, necessary and pervasive as metabolism on the other. The image of formal, public, or summative evaluation as ambitious, ponderous, irrelevant, superficial and devoted to the dogged administration of standardized tests is, perhaps, easy to support with some recent well chosen examples. I have my own collection of horror stories. The real issue I think, is the question of what conceptual and analytic tools are most appropriate to what kinds and stages of curriculum development, dissemination, adoption, implementation and modification or revision? Karplus has mentioned formative and summative evaluation, as well as long-term/short-term; public/private; experimental versus clinical or illuminative. I would like to call attention to the proposition that the field of evaluation seems to suffer not only from a dearth of good examples, but also, paradoxically, from a plethora of models. There does seem to be a shortage of theory and practice in teaching, using and adopting various models.

*Public evaluation, as I understand its meaning here, need not necessarily be destructive or counterproductive. By the same token, private evaluation could be misleading and negative in its consequences.

Here, for example, is a little book that came out about a year ago by Sara Steele. It is called: **Contemporary Approaches to Program Evaluation: Implications for Evaluating Programs for Disadvantaged Adults.***

What Steele has attempted to do is to classify a variety of program evaluation approaches and to give a brief description of each. Nearly 60 models or approaches were included.

Major categories identified are six in number:

1. Evaluation as Input Into Decision Making
2. Evaluation of Program Parts
3. Evaluation—Kinds of Data; Types of Activities
4. Evaluation Processes
5. Results—Attainment of Objectives
6. Results—Evaluation of Outcomes and Effects.

Steele also attempts to classify various approaches according to different frameworks, such as frameworks for examining the impact and larger results of programs; frameworks for examining the results of instruction; frameworks for viewing the program through the eyes of the participant, etc.

Finally Steele attempts an interesting cataloguing. She attempts to match evaluation approaches to problems and needs. She considers three types of problem:

1. programming
2. program management
3. evaluation.

She then lists a large number of problems in, say, programming and suggests for each one or more evaluation approaches that might be helpful.

I am not necessarily endorsing Steele's effort here. There are other similar efforts of even more recent vintage that support the same general proposition. (e.g., a number of authors in Gary Borich's book: **Evaluating Educational Programs and Products**.)† My point in bringing it up is this. There are available a large variety of conceptualizations, techniques and approaches. One may regard this as evidence of a state of blooming, buzzing confusion.‡ Or, one may hypothesize that a variety of evaluation situations, needs and aims

*Educational Resources Division Capitol Publications, Inc., Suite G-12, 2430 Pennsylvania Ave., N.W., Washington, D.C. 20037, 1973.

†Borich, Gary D. (Ed.), **Evaluating Educational Programs and Products.** Englewood Cliffs, N.J.: Educational Technology Publications, 1974.

‡To borrow William James' classic depiction of the perceptual world of the infant.

have begun to give rise to a variety of methods and models from which one can pick and choose judiciously.

I think the same general point applies to other tools of the trade. There are increasingly abundant instruments, procedural checklists, methods and materials. The Social Science Educational Consortium has a detailed model for analyzing curriculum materials. Scriven (in Borich) has recently published a suggested set of standards for evaluating educational products or programs. The dimensions include:*

Student Need
The Market
Performance Data Available
(A series of dimensions here)
Critical Comparisons
Long Term
Side Effects
Process
Statistical significance
Educational significance
Cost-effectiveness
Extended Support

It sounds as though I am suggesting that evaluation, as an operation and a process, now has sufficient constructs, models and methods to proceed in straightforward, effortless, or automatic fashion to support curriculum development and implementation effectively at any state and at no great cost.

Not necessarily so. Evaluation still has basic design problems to confront analogous to those of curriculum design. It seems that curriculum design (as discussed at this conference) wrestles with the perennial questions of:

What to teach?
When to teach?
How to teach?

Similarly, evaluation perforce addresses the question of:†

*Scriven, Michael, Standards for the Evaluation of Educational Programs and In Borich, Gary D. (Ed.), *Evaluating Educational Programs and Products*. Englewood Cliffs, N.J.: Educational Technology Publications, 1974, pp. 5-24.

†C. F. Webb, Wilse B., Measurement of learning in extensive training programs. I. DuBois, Philip H., and Mayo G. Douglas, *Research Strategies for Evaluating Training*. AERA Monograph Series on Curriculum Evaluation, No. 4 Chicago: Rand McNally, 1970, pp. 55-65. Webb focussed on what, how and when to measure as basic problems.

What to observe or measure?
When to observe?
How to observe?

A final point. The agenda mentioned *accountability* as part of our topic. I have found myself pondering the question of accountability in curriculum development. To whom is the curriculum developer accountable, and for what?

Part of the problem here comes about from the concept of accountability. A perusal of the literature does not induce confidence that there is a universal, mutually shared platform here.

In any case, I suggest that one form of accountability in curriculum development was suggested in Jim Robinson's paper. Obtaining and using information about students needs and abilities for different age levels and backgrounds would be one push toward accountability. Similarly, determining teachers' needs and abilities is another. Further explication of the performance characteristics of materials is yet a third.

A basic problem, of course is cost and time. But there is one other problem that is even more perplexing: the lack of a market for such information or data.

The gatekeepers mentioned (givers to teachers, for instance) are truiy apt to make real decisions, in Karplus' terms, on the basis of private criteria and evaluations. There is a substantial job of education needed here.

Pragmatism—The Key to Changing Schools in the Seventies

Ernest Burkman

It must have been great to run a science curriculum project in the early sixties when innovation was everybody's goal; when science could do no wrong, and when dollars flowed freely. Under those conditions, the curriculum developer who could build a better mousetrap, any mousetrap, could confidently expect the world to beat a path to his door.

But today, people in our business work in a far different world. Now, many future-shocked Americans want to slacken the pace of change, and most have become economic conservatives. Furthermore, science now ranks far behind the three Rs on most lists of educational priorities. To be a successful change agent under these conditions one must not only build a better mousetrap, but must also beat a path to the world's door. I will try here to spell out my conception of how to do this.

For brevity, I have organized my remarks into seven propositions as to factors that influence the adoption of curriculum materials. Each proposition is accompanied by a rationale and some implications for curriculum developers. I hope that this form of presentation will sharpen some of the issues and therefore promote discussion.

PROPOSITION 1—Those likely to be affected by a curriculum development effort must participate in its planning and execution.

Rationale—Whether we like to admit it or not, there is a natural mistrust among elements of the science education community (i.e., scientists, science teachers, administrators). Furthermore, being human, educators are not immune to vanity. Involving many people of many types not only insures a curriculum project of important input, but is also the surest way to convert doubters into supporters.

Implication—Development teams should be large and diverse and include scientists, supervisors, teachers, teacher educators, and general administrators from all parts of the country.

PROPOSITION 2—Field testing is an act of dissemination as well as a way to collect feedback.

Rationale—Most teachers and school districts assume that their problems are totally unique. Seeing curriculum materials being successfully used in local or nearby classrooms is the strongest motivation for adoption.

Implication—Field testing should involve large numbers of students distributed nationally according to population density.

PROPOSITION 3—Curriculum projects must specifically design their final product to be sold at a profit in a highly competitive market.

Rationale—To achieve wide distribution, most projects must turn to a commercial publisher. The only way to attract and maintain the cooperation of a first-line publisher is to insure *during development* that the final package makes sense commercially as well as pedagogically.

Implication—*During development*, projects must accept whatever constraints are required to insure that; (1) the commercial selling price of the final package will be competitive, (2) the publisher will have the exclusive sales rights to enough material with enough sales potential to generate a profit, and (3) the form of the final package does not preclude adoption by large numbers of prospective users.

PROPOSITION 4—Curriculum materials must be designed such that their implementation does not depend upon extensive modification of existing school facilities or large expenditures for new equipment.

Rationale—The population trend means that future science instruction will be done almost entirely in existing buildings and classrooms. Furthermore, school science budgets are in a period of continuing decline. Under these conditions schools will reject any program that calls for large investments in plant or equipment.

Implication—Projects should exclude learning activities which require large expenditures for implementation regardless of their pedagogical advantages.

PROPOSITION 5—The content of new curriculum materials must be consistent with existing course patterns.

Rationale—Strong arguments can be made as to the validity of what is and is not included in the science curriculum and the way science courses are presently structured. But teacher training and certification, classroom design and equipment, graduation requirements, and other vital matters have been geared to what exists and thus serve as powerful deterrents to change. In the face of these biases, adoption of totally new content thrusts is most difficult and unlikely.

Implication—Projects seeking to infuse new content into the curriculum should do so by adding new parts to old courzes rather than by demanding or assuming wholesale course deletions and additions.

PROPOSITION 6—New curriculum materials and approaches must be useable by present teachers.

Rationale—Much evidence suggests that over the next several years, relatively few new teachers will enter the profession. This means that science curriculum developers must count on people already in the classroom to implement their products rather than hope for better prepared new teachers.

Implication—Although you can teach old dogs some new tricks, you can't make a bird dog out of a Chichuahua. Projects must temper their zeal to introduce new content and instructional procedures to match what can realistically be expected of teachers whose training and experience is in different directions. Normally this means the project must forego some of its aspirations.

PROPOSITION 7—Curriculum projects must release their final products at a time of high interest in the type of innovation being promoted.

Rationale—Social conditions, more than any other factor, determine school curriculum practices. Curriculum materials that promote directions that are counter to existing social trends are not likely to have much impact. Good materials can stimulate or institutionalize directions that are already underway, but rarely do they initiate new movements.

Implication—Projects that are totally out of tune with social conditions should not be started, and those that are in tune should be completed with dispatch to avoid losing the 'teachable moment.'

I realize that some curriculum developers will be unhappy with my propositions. They will say something to the effect that Michelangelo would never have created David if he had focused on making his creations fit social conditions, on meeting deadlines, and on the price of marble.

My response is that developers wanting to be in the David producing business should ignore the nuts and bolts matters that I have mentioned and concentrate on producing the world's best science curriculum. I hasten to point out, however, that most of the world's best science curricula that have been produced to date are found on library shelves, not in classrooms.

Reaction to "Pragmatism—The Key to Changing Schools in the Seventies"

Emil Joseph Piel

Dr. Burkman has indicated a number of problems which face us in the implementation of new curricula in the seventies and eighties. While I agree with the essentials of the statement of the problems, I find myself in strong disagreement with many of the propositions and implications indicated as ways to solve them.

There is no question that educational institutions are resistant to change. The question is whether we should accept this resistance as essentially insurmountable as seems to be implied by Dr. Burkman, and concentrate on short term success, or should we work to develop and implement curricula which will bring about those changes which are most desirable, or should the National Science Foundation support a combination of short term and long term programs?

A logical way in which to react to Dr. Burkman's remarks will be to respond to the various propositions, rationales, and implications in the order in which they were presented. I will spend more time on those with which I disagree most strongly.

If Proposition 1 is valid, that those likely to be affected by a curriculum development *must* participate in its planning and execution, either NSF or USOE or some national group *must* support the inclusion of the sixty million or so students in schools as they participate in the planning and execution of national curricula or there should be no nationally developed curricula. It is the students who *should* be the ones most likely to be affected by a curriculum development effort.

This is the group for whom we claim to be developing the courses and materials. In actual practice however, it is often the scientists, science teachers, and administrators who are affected and the final effect never gets to the students.

The implication of this proposition did not include even the mention of token student participation in the program development and this is regrettable.

Student participation aside, another question arises on widespread inclusion of teachers, administrators, etc. and that is the question of timing. With the present economic situation, it is not feasible to include large numbers of people in curriculum development at the very outset, or planning phase, and yet this is when

the philosophy, objectives, and approach are usually set. (With 25,000 secondary schools in the U.S. a group of 250 secondary school people would be only a 1% representation.)

And so while I agree with the proposition, if it includes students and eliminates the word *must*, I have strong reservations as to the rationale and implications as stated by Dr. Burkman and the economic feasibility if carried to any reasonable conclusion.

Once the philosophy, objectives and approach are stated by the planning group, the great masses of teachers and students either accept them, reject them or modify them for their own use. It is unrealistic to believe that more than a handful of people are going to be involved in the actual planning.

Proposition 2 is straightforward and logical. Field testing is indeed an act of dissemination as well as a way to collect feedback. My only concern here is the realism of field testing with large numbers of students. The larger the numbers of students involved, the greater the variety of observers (or filters) through which the feedback must be returned and the less valid such feedback becomes. If on the other hand the feedback is to be ignored anyway, which I have seen happen, then the dissemination value of using large numbers of students is the overriding consideration. It would seem that a small number of feedback centers which were chosen for their resistance to the Hawthorne Effect might be a more feasible way to obtain valid feedback while including the large numbers in a second phase for the sake of developing a firm dissemination base. Wide dissemination is a result of having many enthusiastic satisfied customers selling the materials. These are not the kinds of people who provide the most critical feedback.

Proposition 3—Curriculum projects must specifically design their final product to be sold at a profit in a highly competitive market.

This is a proposition up with which I will not put. I still believe that curriculum projects must specifically design their final products to meet the educational needs of the community for which they are being designed. This is the major *criterion*. One of the *constraints* is that it must be sold at a profit in a highly competitive market. This statement is not just a matter of semantics or rhetoric but of philosophy. I can still recall being told by a publisher for whom I was writing test questions that while my questions were creative measures of the cognitive learning of the students they were not geared to specific pages of the text and therefore would not help to sell books. Other than discussions on contract termination, that was the last conversation I had with that publisher.

The implication which I see for this proposition is that NSF should close up its Curriculum Development Shop and turn this chore over to the publishers who know what will sell at a profit in a highly competitive market and we can go back to physics books with four color transparent overlays of the steam shovel.

While I object to the proposition, I can agree with the implication statements with reservations. They are that projects must accept *some* but not *whatever* constraints to insure that the commercial selling price will be competitive, publisher will have exclusive sales rights, and that the final package will have reasonable numbers of sales. The development of materials for the very bright potential scientists/engineers or for the educationally handicapped might be seriously hampered by adhering to this proposition and the stated implications. For example, computer materials would still not be developed if this proposition had been followed in the 1960's.

Proposition 4—While I agree in principle with the proposition that most projects should refrain from developing curricula which require large expenditures for new equipment, there would be little progress in the entire area of computers in the curriculum if this had been followed by all curriculum projects in the past. For example, at the present time all high schools in Rhode Island have access to computers for educational purposes, as well as 60% of those on Long Island, at least half in Oregon and Delaware, and 100% in Raleigh, N.C., Philadelphia and Washington D.C., to name but a few which come immediately to mind.

None of these would be this far along if it were not for USOE and NSF support of projects which *did* require large expenditures for new equipment.

It is true that the computer manufacturing companies have also pushed for this acceptance. It is also true that the chaotic situation regarding educational computing facilities on college campuses is due to the fact that the introduction of computers to colleges was through the manufacturers rather than through curriculum reform.

To state that schools will reject any program that calls for large investments in plant or equipment is to accept a return to the textbook and chalkboard and to forget any experimentation with new approaches to teaching through the use of educational technology such as computers, television, tape recorders, etc.

To *exclude* learning activities . . . regardless of their pedagogical advantages is to develop nothing new if it costs money. When a school administrator says "I like your program but it costs too

much" what he really means is "I don't like your program enough to spend the money on it."

Prices on equipment are reduced when large numbers of people are willing to buy it. For example during the decade from 1964-1974 the prices of color T.V.'s, radio's, calculators, etc. have gone down primarily because the demand is great enough to warrant mass production. An oscilloscope with a fraction of the components and circuits of a T.V. costs about five times as much for a comparable size screen.

Proposition 5—"The content of new curriculum materials must be consistent with existing course patterns." This proposition like many of the preceding ones accepts the status quo as correct and irrefutable. If we really believed that none of us would be here today. It is true that the adoption of new conten. thrusts at changing existing course patterns (just to see what happens) than to support only programs which result in little more than a text revision, or a new unit of study here or there to be fed into present existing dull courses.

A quick and dirty survey of two schools in the immediate vicinity of my office indicates the following additions to the curriculum SINCE 1970.

Oceanography
Expository Writing
Social Psychology
Criminology
Power Mechanics 3 (Building Racing Car)
Electronics 3
Cooperative Industrial Education
World/Urban Geography
Eastern Thinking in Western Literature
Existentialism & Alienation in Modern Literature
Science Fiction
Techniques of Persuasion in Fiction and the Mass Media
Social Problems of Today Explored through Literature
Critical Thinking
The Progressive Era & The Twenties
You and the Law
Environmental Science
Evolution
Computer Science I, II, III
Problems in Consumerism
Tailoring
Girls Metal Working and Auto Maintenance
The Supreme Court
Urban American Life
Experimental Biological Literature
Environmental Chemistry
Algebra II with Computer Programming
Interior Decoration
Ceramics
Health Careers

While many of these might be considered as 'mickey mouse' courses —to which none of us would subscribe, the point is that schools *are* willing to put in new courses.

Interestingly, these are schools which have consistently faced the problems of voters turning down budgets during these same five years, as well as in previous years.

This is not to deny the fact that change can come about by adding new parts to old courses and gradually pushing out the old material, but to assume that it is the only way is to put the same restrictions on educational progress as now exist with college board and New York regents examinations.

Proposition 6—New curriculum materials and approaches must be useable by present teachers.

While I agree with the rationale that relatively few few teachers will enter the profession, I cannot accept the concept that projects must match what can realistically be expected of teachers whose training and experience ended in 1970. I would much prefer that curriculum change be the impetus behind the re-education of these teachers who will be with us for the next two or three decades. The implication here should really be that more money must be spent in teacher education for the purpose of implementing new curricula.

Proposition 7—Curriculum projects must release their final products at a time of high interest in the type of innovation being promoted.

It is good to hear that we are still interested in promoting innovation. After listening to propositions 3 through 6 I began to feel that we are not expected to do anything new. However, to say that we will time the release of final products at a time of high interest is again to assume that our final products will not be leading the changes in schools but following them.

If education in 1980 is totally out of tune with social conditions (which I suspect it will be) and we are to agree with propositions 3-6, which tend to keep us on the narrow track of the status quo, then curriculum development will also be out of step with social conditions and therefore, according to this statement, should not be started.

The social conditions of the fall of 1974 are energy crisis, pollution problems, economic crisis, political crisis, crime, food crisis and an overriding population problem.

How many texts on the above subjects are being sold in the highly competitive market? How do we study these and still be consistent with existing course patterns? How many of the teachers studied these problems in their preparation? And finally, how many curriculum projects which follow propositions 3 through6 6 are in tune with these conditions?

If as Dr. Burkman says in his concluding remarks, most of the world's best science curricula are found on library shelves, and not

in classrooms then we should concentrate our efforts on getting them off the shelves, not on developing second or third rate programs just because they will sell.

This then is the problem which we as curriculum developers and the National Science Foundation face.

Shall we:

1. Work to develop curriculum programs which will show the way for the next decade?
2. Work to develop curriculum programs which will not be very innovative, but which will sell?
3. Concentrate our time, effort, and financial resources on getting the *best* science curricula of the past decade off the shelves and into the classrooms?

   or

   as we recall from some of the poorly written tests of the nineteen fifties;
4. None of the above?

These are some of the problems with which I suggest we wrestle during the remainder of this session.

AGENDA

PES/MIDS Project Directors Meeting
CURRENT ACTIVITIES AND THE TASK AHEAD

Airlie House
September 13-15, 1974

Friday, September 13

8:30 p.m.	Opening Session—Laurence O. Binder, Presiding

Saturday, September 14

9:00 a.m.	Plenary Session—Jean B. Intermaggio, Presiding
	Topic: The Challenge of Developing an Interdisciplinary Curriculum
	Presenter: Peter B. Dow
	Reactor: James T. Robinson
10:15 a.m.	Small Group Discussions (six)
11:15 a.m.	Reporting Session
2:00 p.m.	Plenary Session—James W. Wilson, Presiding
	Topic: Evaluation-Formative, Summative, Accountability
	Presenter: Robert Karplus
	Reactor: H. Russell Cort, Jr.
3:15 p.m.	Small Group Discussions (six)

4:15 p.m.	Reporting Session
8:00 p.m.	Group Discussions—Participants' Choice

Sunday, September 15

9:00 a.m.	Plenary Session—Daniel C. Yohe, Presiding
	Topic: Dissemination and Implementation Presenter: Ernest Burkman Reactor: E. J. Piel
10:15 a.m.	Small Discussion Groups (six)
11:15 a.m.	Reporting Session
1:30 p.m.	Small Discussion Groups (six)
	Topic: New Directions
2:30 p.m.	Plenary Session—Raymond J. Hannapel, Presiding
	Panel Discussion—New Directions
4:00 p.m.	Adjournment

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1975/76

CONFERENCE EVALUATION

At the end of the conference, the participants completed a conference evaluation questionnaire. The majority of the participants responded favorably to the first statement on the questionnaire: "This conference has been useful for me." The responses were:

2 strongly disagree
2 disagree
36 agree
18 strongly agree

Responses to the second item on the questionnaire regarding various aspects of the conference were as follows:

	Poor	*Adequate*	*Good*	*Excellent*
Presentations and Reactions	2	6	33	15
Small Group Discussions	5	10	32	6
Location and Facilities	0	2	17	35

The third item on the questionnaire was the open-ended question, "What do you feel has been the strongest point?" The strongest points of the conference appeared to be: 1) that it provided an opportunity to exchange information among projects, and 2) that it provided an opportunity to interact with persons of varied interests and points of view. The general tone of the responses to this item indicate that the participants felt that this was a

well-planned conference that focused on issues, not on 'show and tell,' and that in an informal, relaxed setting it provided an opportunity to sharpen old ideas and develop new ones concerning needs in science curriculum in the schools.

Responses to the final question, "What do you feel has been the weakest point?" indicated that the participants would have liked to have had more time to exchange information, both in the organized "small groups" and in informal gatherings.